6th International Conference Sustainable Agriculture, Food, and Energy (SAFE2018). October 19-21, 2018 I'M Hotel, Makati. MANILA, PHILIPPINES

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6th International Conference Sustainable Agriculture, Food, and Energy (SAFE2018). October 19-21, 2018 I'M Hotel, Makati. MANILA, PHILIPPINES

Preface

We are proud to inform you that the International Conference on Sustainable Agriculture, Food, and Energy (SAFE2018): Inclusive Agri-food Energy Production for Community Empowerment in a Changing Climate" was successfully conducted by SAFE-Network from October 19-21, 2018 in MANILA, Philippine. The host institution was Pampanga State Agricultural University (PSAU), Philippines Centre for Postharvest and Mechanization (PhilMech), and Central Bicol State University of Agriculture (CBSUA), Philippines This conference was the 6th conference after the 1st International Conference on Sustainable Agriculture, Food, and Energy (SAFE2013) in Padang, Indonesia (12-14 May 2014), the 2nd conference SAFE2014 in Bali, Indonesia (17-19 September 2014). The 3rd conference SAFE2015 in Ho Chi Minh City, VIETNAM (17-19 November 2015), The 4th conference SAFE2016, Colombo, Sri Lanka (October 20-22, 2016), and the 5th conference SAFE2017, Malaysia, August 22-24, 2017.

The objectives of the conference were:

1. To provide a forum for international researchers community to exchange and share the experiences, new ideas, sustainability concepts and research results on sustainable agriculture, food, and energy.
2. To promote collaboration in research on sustainable agriculture, foods, and energy production. To establish a regional networking among participants on sustainable agriculture, food, and energy.
3. To increase awareness of the importance of living and working in the manner that enhances the economic, environmental and social well-being of our community through research, education, regional partnerships, and community engagement.

The committee accepted 150 papers of over 300 papers which were presented in SAFE2019 conference.

On behalf of SAFE-Network, we would like to convey our appreciation and thanks very much to the Pampanga State Agricultural University (PSAU), Central Bicol State University of Agriculture (CBSUA), and Philippines Centre for Postharvest and Mechanization (PhilMech) for co-hosting this conference.

We would like especially to thank Prof. Dr.Tafdil Husni, Rector of Andalas University for his strong support to this event, Dr. Norman de Jesus, local conference coordinator and the members of the local organizing committee who helped with all the preparations required to make the conference a success, as well as the session organizers who worked to ensure a high level of science presented at the meeting. Moreover, of course, we thank all honourable speakers and participants who have agreed to attend and discuss your work! Finally, please understand that while every effort was made to publish this proceeding, we know that unavoidable withdrawals and other changes will occur.

Looking forward to welcoming you to the SAFE2019 conference in Phuket, THAILAND!

Prof. Dr. Novizar Nazir
SAFE-Network Executive Chairman


SAFE 2018
6th International Conference on
Sustainable Agriculture, Food, and Energy
"Inclusive Agri-food Energy Production for
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Farm Power Sources and Machinery Contribution in Small Rice Farming Operations in Kampar Region, Indonesia

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Farm Power Sources and Machinery Contribution in Small Rice Farming Operations in Kampar Region, Indonesia

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Abstract. Farm power is one of the important inputs in agriculture. Farm machinery is farm power source which has been increasingly used by farmers as instead of manual tools and animal power. This paper attempts to identify farm power sources and machinery contribution in small rice farming operations in Kampar Region, Indonesia. Field survey was conducted in the region and 30 rice farmers were interviewed to collect primary data. Descriptive-quantitative approaches ware used to analyse data, including percentage, mean, and graphical methods. The results showed that the farm machinery was used by farmers to perform rice farming operations in survey areas. The most popular and dominant power sources were human and machine powers. The machine power came from hand tractors, irrigation (water) pumps, power threshers, and rice milling units. They increased during the period of 2012-2016 and total number of power available on farm also increased during the same period. The contribution of machine power for total power was significant and would become more important in the future. Therefore, there is a need to increase the number and type of the farm machinery in the region in order to increase the availability of farm power and eventually increase rice production and productivity.

1. Introduction

Agricultural operations are physical works requiring much power. Hunt [1] defined power as the rate of doing work and farm work is physically demanding power and the working conditions are often harsh [2]. As a necessary input in farming system, therefore, the power has become increasingly important to perform different types of farm work. Farm work in farming system can be categories into tractive work – such as land preparation, transplanting, harvesting and transportation and stationary work- such as threshing, milling, and lifting of irrigation water [3].

In addition, mechanized agricultural operations can also be grouped into power intensive operations – such as land preparation, threshing, grinding and milling, is characterized by non-human sources of energy input to replace human and animal ones required in the operations, and control intensive operations - such as planting, weeding, winnowing, fruit harvesting, require greater human judgment and mental input in addition to energy [4,5]. These operations can be performed by different sources of power, i.e., human, animal, mechanical power, and electrical power. Currently, these types of farm power have being used by farmers for doing primarily rice farming operations at the different levels of application.

In traditional farming system in the developing countries, human and animal powers are usually more dominant. According to Srivastava et al.[2] the power for early farming operations was primarily human labour and later, draft animals were used as the source of power. The problem is that these power sources have low efficiency and very slow in work due to low power [6]. An adult man, for instance, can produce an average of 0.1 HP of power output [7]. Consequently, most of traditional farming remains inefficient and unproductive, so agricultural production goals are difficult to be achieved.

Currently, the agricultural system has changed toward modernization with replacing manual tools and animal-drawn implements by mechanical power technology. The main reason is that the mechanical power technology (machinery) offers more power and high efficiency. Moreover, the use of machines can reduce the burden and drudgery of farm work and to increase the output per worker [8]. Increasing productivity, expanding cultivation area, and improving quality work and products are among the other reasons [9]. Therefore, many developing countries, including Indonesia, have rapidly introduced mechanical power in order to modernize agricultural system and to increase production.

In Indonesia, the use of mechanical power in agriculture especially for rice cultivation has been showing an increasing trend, although the pace is slow [10]. Therefore, there is the need to identify the power sources for farming operations during the data is not completely available. This research attempts to identify farm power sources and machinery contribution in small rice farming operations in Kampar Region, Indonesia.

2. Materials and Methods

The research was conducted in Kampar Region which is one of rice production centres in Riau Province, Indonesia. According to Annual Report of Agricultural Crops Services of Kampar Regency [11], there are about 744.478 hectares of agricultural land from the total of region areas of 1,128,928 hectares. The agricultural area is dominated by plantation area which reaches 415.702 ha and paddy field area is only 6.546 hectares. However, rice is important crop in the region to feed about 734.948 of the total region population. Currently, local government has thrived to develop mechanization mainly farm machinery use for increasing rice production and productivity. Consequently, the application of farm machinery for rice cultivation has increased significantly especially in the centres of rice production.

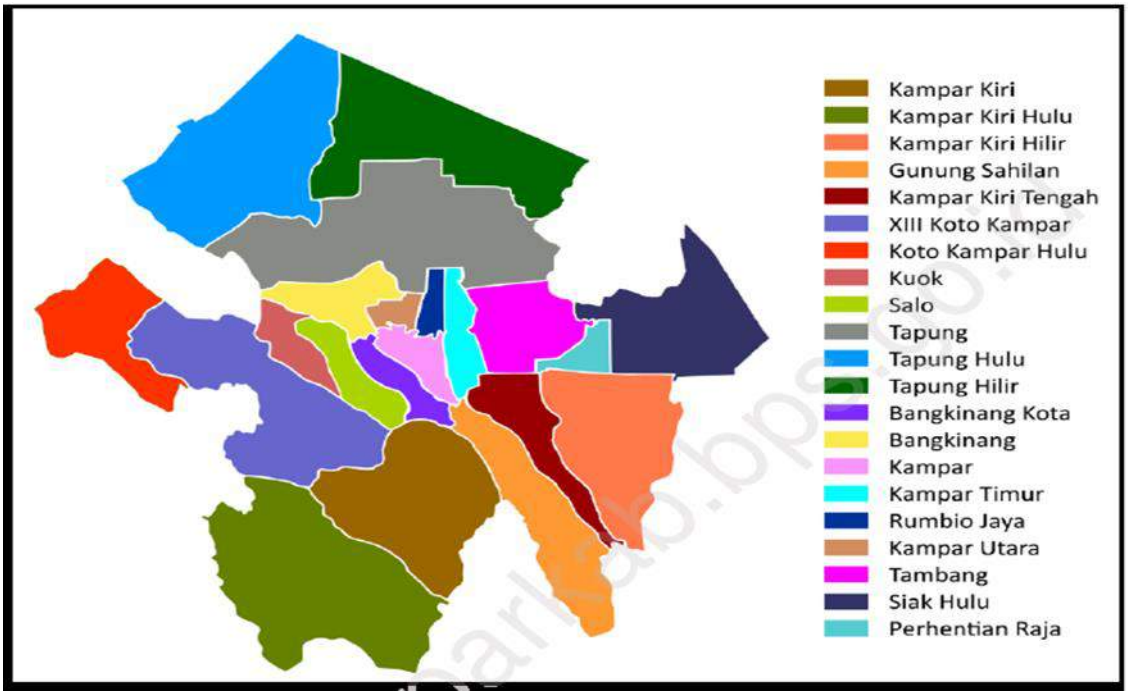

Figure 1. Map of Kampar Region

The data were collected from primary and secondary sources in 2017. The primary sources of data include information obtained from personal interview with respondents and field observations. The respondents consisted of farmers (machine users) and machinery managers and machinery owners. Farm machinery in Kampar Region is managed by individual and group farmers [12]. Farm machinery which is directly aided by government managed by group farmers and they offer hire services for group members. While, the secondary sources of data were obtained from agricultural documents such as journals, bulletins, conference papers, annual report publish by statistical bureau and local government

etc. The collected data were tabulated and then analysed using descriptive-quantitative techniques, including percentage, mean, and graphical methods.

3. Results and Discussion

3.1. Machinery Availability

Major farm machinery popularly used by small rice farmers in Kampar Region consists of hand tractors, 4-wheel tractors, power threshers, irrigation pumps and rice milling units. According to Table 1, the most of the farm machines available in the region is power threshers, while the smallest one is 4-wheel tractors. Generally, the number of the farm machines increased every year during a period of 2012 – 2016. The highest increasing rate was found on power thresher (419%) and followed by 4-wheel tractor (28%) and irrigation pump 13%, while the lowest growth was hand tractor (9%) annually during the same period.

Table 1. Number of major farm machines used in Kampar Region during 2012 – 2016.

Type of machinery	2012	2013	2014	2015	2016
Hand tractor	165	160	188	207	230
4-wheel tractor	0	4	8	8	9
Power thresher	37	653	687	689	741
Irrigation Pump	190	211	232	294	310
Rice milling unit	61	64	65	85	88

Source: Food crops, Horticulture and Plantation Services, 2013-2017

Moreover, Table 2 shows that the number of paddy field area that can be worked by one machine in Kampar Region was still high. For example, one hand tractor worked at a range from 28 to 64 ha. Number of hectares per machine for full mechanization is about 10 ha or equivalent to 100 hand tractor/1000 ha). These results indicate that the number of farm machines is not sufficient to perform the available paddy field area.

Table 2. Number of area worked by one machine in Kampar Region.

Type of machinery	Number of area per machine (ha)				
	2012	2013	2014	2015	2016
Hand tractor	64	67	48	33	28
4-wheel tractor	0	2,670	1,117	856	727
Power thresher	286	16	13	10	9
Irrigation Pump	56	51	39	23	21
Rice milling unit	173	167	137	81	74

Note: 10 hectares required one farm machine for full mechanization level

3.2. Power Sources

Generally, power sources in agriculture come from human, animal, mechanical (machine), and electrical power. In Kampar region, human and machine powers are more popular and dominant power source to be used especially for rice cultivation, while animal power is not used anymore today. Table 3 presents development of paddy filed area, rice productivity, and machine power sources in the region during the period 2012-2015. Paddy field area has decreased as 38% from 10,580 ha to 6,546 ha during the period of 2012 - 2016. This decrease is because of conversion use of paddy field area to other uses, such as plantation, housing, road etc. The rice productivity did not grow significantly and the growth rate was only 0.8% annually or increasing slightly from 4.78 t.ha-1 to 4.92 $t.ha^{-1}$.

Furthermore, the number of power that comes from farm machines increased significantly from 4,682 kW in 2012 to 10,320 kW in 2016 totally. The machine power has experienced 25% annually during the period. The increasing the total number of power caused the increase of machine power per hectare from 0.44 kW in 2012 to 1.58 kW in 2016 with annual growth of 40%.

Table 3. Paddy field area, rice productivity and power source di Kampar Region during a period of 2012-2016.

Year	Paddy field area (ha)*	Rice productivity (t.ha-1)*	Machine power	
			(kW)	(kW.ha-1)
2012	10..580	4.78	4.682	0.44
2013	10..679	4.70	8.557	0.80
2014	8..934	4.99	9.149	1.02
2015	6..845	4.87	9.738	1.42
2016	6..546	4.92	10.320	1.58

Sources: *Food crops, Horticulture and Plantation Services, 2013-2017

Another important source of power for rice farming operations in Kampar Region was human power. This power came from man and woman farmers as labour in rice farming operations. This power was calculated under assumption that power output from a man is 0.1 HP and a woman is 0.075 HP [6]. During the period 2012 -2016, the human power grew 0.9% annually, increasing from 13,407 kW to 13,834 kW. Consequently, the number of human power per hectare also rose from 1.27 kW in 2012 to 2.11 kW in 2016 with annual growth of 14%.

Table 4. Development of Human power in Kampar Regency during a Period of 2012 – 2016.

Year	Human power (kW)			Number of power ($kW.ha^{-1}$)
	Male	Female	Total	
2012	10,254	3..153	13,.407	1.27
2013	11..141	3..349	14,490	1.36
2014	11..075	3..432	14,507	1.62
2015	10..359	3..210	13,570	1.98
2016	10..592	3..242	13,834	2.11

3.3. Total Power and Machine Power Contribution

Total power was calculated by adding human and machine powers. The number of power available in Kampar Region for rice farming operations increased from 1.71 $kW.ha^{-1}$ in 2012 to 3.60 kW.ha-1 in 2016 as presented in Figure 2. According to Jain [17], there is a need for a power input at least 0.8 kW.ha-1 for effective and efficient farm operations. The result indicated that the power available on farm in Kampar Region was more than the minimum requirement and even more than national average of 0.41 $kW.ha^{-1}$ [18]. However, the figure was less than Japan (7.0 $kW.ha^{-1}$) and Korea (4.11 $kW.ha^{-1}$).

The increase of farm power was contributed by machine power in average of 36%, increasing from 24% to 39% for 2012 and 2016, respectively. While, the contribution of human power was about 66% on average and decreased from 74% in 2012 to 57% in 2016. The results reveal that the use of human power has slowly decreased every year, whereas machine power has slowly increased year by year. This trend shows that transformation of mechanization technology from human tools to farm machines has been happening slowly and continuously. It becomes important to modernize traditional farming system in Kampar Region.

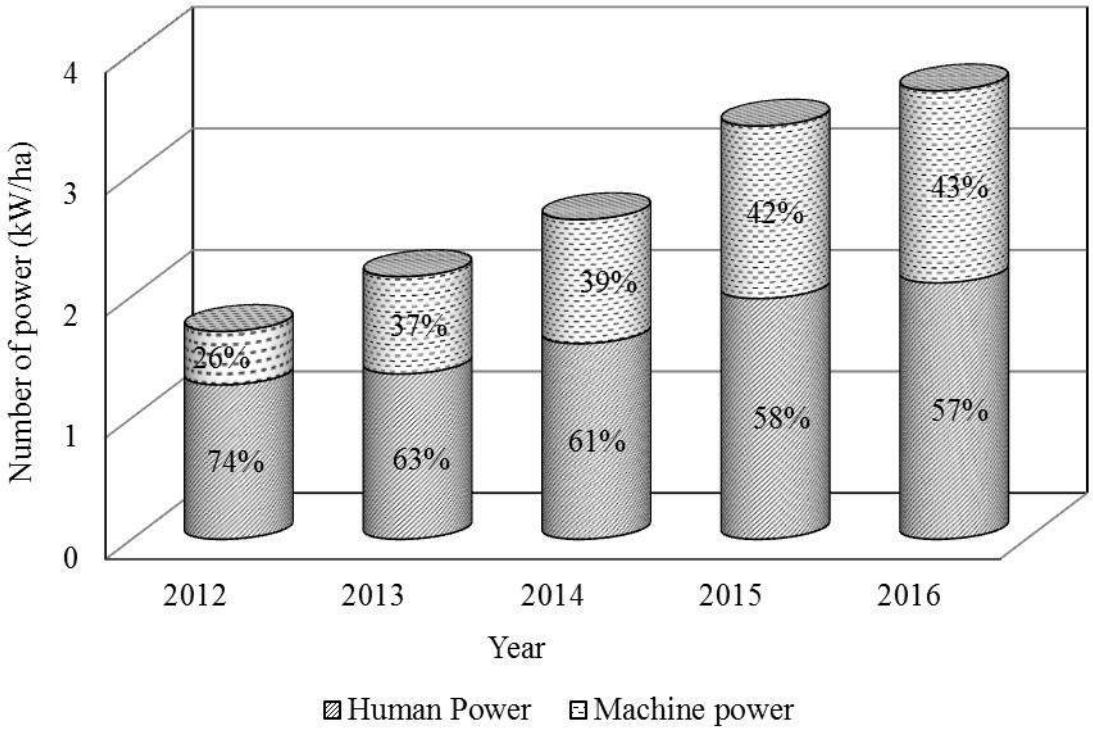

Figure 2. Contribution of human and machine powers on total power in Kampar Region during a period of 2012 – 2016

4. Conclusions

The most popular farm machines were used by farmers hand tractors, irrigation (water) pumps, power threshers, and rice milling units. Both machine and human powers were the main sources and dominant power for rice farming operations in Kampar Region. The number of the major farm machines increased every year during a period of 2012-2016. However, the number and type of machines available on farm was not sufficient to make effective and efficient farm operations which require about 100 machines per 1000 ha farm area. Total number of power available on rice farm also increased during the same period. Total power per hectares reached 3.60 $kW.ha^{-1}$ in 2016 and the figure increased from 1.71 $kW.ha^{-1}$ in 2012. However, the contribution of machine power for total power was significant and would become more important in the future. The findings suggest for increasing the number and type of farm machines in the region in order to increase the availability of farm power and eventually increase rice production and productivity.

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